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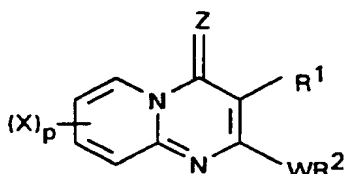
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CQT CQU CTR C1173 C1410 C1510 C1530 C1532
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C700 C748 C761 C762 C771 C775 C80Y C805
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RS222 RS352 RS440
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(56) and (58) continued overleaf

(54) Fungicidal pyridopyrimidines

(57) Substituted pyrido[1,2-a]primidinones of formula I



(I)

wherein

R¹ is an optionally substituted aryl or heteroaryl group;

Z is O or S; W is O, S(O)_n or NR³;

R² and R³, which may be the same or different, are each hydrogen or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group; each X, which may be the same as or different from any other X, is halogen, CN, NO₂, SF₅, acyl, O-acyl, trialkylsilyl, B(OH)₂ or a group D, OD or S(O)_nD where D is a group as defined hereinbefore for R² or is optionally substituted amino and n is O, 1 or 2; or two adjacent groups X together with the atoms to which they are attached form a carbocyclic or heterocyclic ring; p is 0 to 4; and n is 0 to 2, most of which are novel compounds, have useful fungicidal activity.

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(56) Documents Cited

Chemical Abstracts 59:12819f,g Chemical Abstracts 52:12872f,g

(58) Field of Search

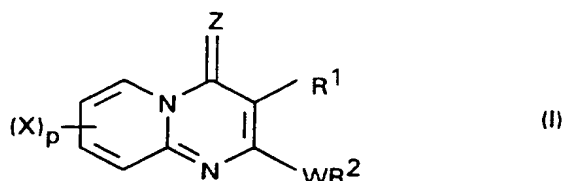
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Online: CAS ONLINE

Case 95C121Fungicides

This invention concerns compounds having fungicidal activity.

- 5 In one aspect, the invention provides the use in combating fungi of the substituted pyrido[1,2-a]pyrimidinones of the formula I



wherein

R¹ is an optionally substituted aryl or heteroaryl group;

10 Z is O or S;

W is O, S(O)_n or NR³;

R² and R³, which may be the same or different, are each hydrogen or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group;

each X, which may be the same as or different from any other X, is halogen, CN,

15 NO₂, SF₅, acyl, O-acyl, trialkylsilyl, B(OH)₂ or a group D, OD or S(O)_nD

where D is a group as defined hereinbefore for R² or is optionally

substituted amino and n is 0, 1 or 2; or two adjacent groups X together

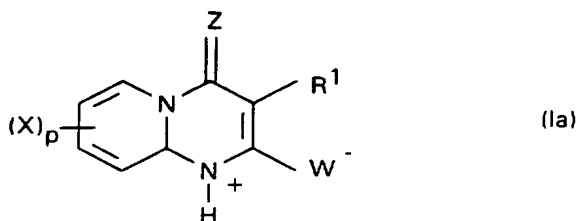
with the atoms to which they are attached form a carbocyclic or

heterocyclic ring;

20 p is 0 to 4; and

n is 0 to 2.

It will be appreciated that when R² is hydrogen, the compounds of formula I can exist in the zwitterionic tautomeric form of formula Ia



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Most of the above compounds are new, and we accordingly provide per se the compounds of formula I with the exception of the following compounds where Z is O:

	R^1	WR^2	$(X)_R$
5	Ph	OH	6-NH ₂
	Ph	OH	6-Me
	Ph	OH	8-Me
	Ph	OH	-
	Ph	OH	9-OH
10	Ph	Oallyl	-
	Ph	OCH ₂ CH ₂ NEt ₂ -	
	4-OMePh	OCH ₂ CH ₂ NEt ₂ -	
	4-OMePh	OH	-

- 15 Any alkyl group present in the molecule is preferably of 1 to 10 carbon atoms, especially of 1 to 7 carbon atoms, and particularly of 1 to 5 carbon atoms, and may be unsubstituted or substituted.

- 20 Any alkenyl or alkynyl group present in the molecule is preferably of 2 to 7 carbon atoms, for example allyl, vinyl or propargyl.

Any cycloalkyl group present in the molecule is preferably of 3 to 7 carbon atoms, especially cyclopropyl, cyclopentyl, or cyclohexyl.

- 25 Substituents, when present on any alkyl, alkenyl, alkynyl or cycloalkyl moiety may for example be halogen, cyano, optionally substituted alkoxy, optionally substituted alkylthio, hydroxy, nitro, optionally substituted amino, acyl, acyloxy, optionally substituted phenyl, optionally substituted heterocyclyl, optionally substituted phenylthio, optionally substituted phenoxy, optionally substituted
- 30 heterocycloxy, optionally substituted heterocyclylthio or oxidised derivatives of thio-containing groups.

Cycloalkyl groups may also be substituted by alkyl.

The term 'aryl' is used herein to mean aromatic carbocycles, which may be mononuclear, e.g. phenyl, or polynuclear, e.g. naphthyl. Any aryl group present in the molecule is preferably a substituted or unsubstituted phenyl group.

The term heteroaryl is used herein to mean aromatic heterocyclyl groups.

- 5 Heteroaryl groups are generally 5 or 6-membered rings containing up to 4 hetero atoms selected from nitrogen, oxygen and sulfur, optionally fused to a benzene ring. Examples of heteroaryl groups are those derived from thiophene, furan, pyrrole, thiazole, oxazole, imidazole, isothiazole, isoxazole, pyrazole, 1,3,4-oxadiazole, 1,3,4-thiadiazole, 1,2,4-oxadiazole, 1,2,4-thiadiazole, 1,2,4-triazole, 10 1,2,3-triazole, tetrazole, benzo[b]thiophene, benzo[b]furan, indole, benzo[c]thiophene, benzo[c]furan, isoindole, benzoxazole, benzothiazole, benzimidazole, benzisoxazole, benzisothiazole, indazole, benzothiadiazole, benzotriazole, dibenzofuran, dibenzothiophene, carbazole, pyridine, pyrazine, pyrimidine, pyridazine, 1,3,5-triazine, 1,2,4-triazine, 1,2,4,5-tetrazine, quinoline, 15 isoquinoline, quinoxaline, quinazoline, cinnoline, 1,8-naphthyridine, 1,5-naphthyridine, 1,6-naphthyridine, 1,7-naphthyridine, phthalazine, pyridopyrimidine, purine or pteridine.

- 20 The term heterocyclyl includes both heteroaryl groups as described above and non-aromatic heterocyclyl groups.

- Non-aromatic heterocyclyl groups are generally 3, 5 or 6-membered rings containing up to 3 hetero atoms from nitrogen, oxygen and sulfur, for example oxiranyl, thiiranyl, thiazolanyl, dioxolanyl, 1,3-benzoxazinyl, 1,3-benzothiazinyl, 25 morpholino, pyrazolanyl, sulfolanyl, dihydroquinazolinyl, piperidinyl, phthalimido, tetrahydrofuranyl, tetrahydropyranyl, pyrrolidinyl, indolanyl, 2-oxopyrrolidino, 2-oxobenzoxazolin-3-yl.

- 30 Substituents when present on any aryl or heterocyclyl group may for example be halogen, CN, NO₂, SF₅, acyl, O-acyl or a group D, OD or S(O)_nD as defined hereinbefore; or two adjacent groups on the ring together with the atoms to which they are attached form a carbocyclic or heterocyclic ring, which may be similarly substituted.

The term acyl includes the residue of sulfur and phosphorus-containing acids as well as carboxylic acids. Examples of acyl groups are thus $-\text{COR}^5$, $-\text{COOR}^5$, $-\text{CZNR}^5\text{R}^6$, $-\text{CON}(\text{R}^5)\text{OR}^6$, $-\text{COONR}^5\text{R}^6$, $-\text{CON}(\text{R}^5)\text{NR}^6\text{R}^7$, $-\text{COSR}^5$, $-\text{CSSR}^5$, $-\text{S}(\text{O})_q\text{R}^5$, $-\text{S}(\text{O})_2\text{OR}^5$, $-\text{S}(\text{O})_q\text{NR}^5\text{R}^6$, $-\text{P}(=\text{Z})(\text{OR}^5)(\text{OR}^6)$, $-\text{CO-COOR}^5$, where R^5 , R^6 and R^7

5 which may be the same or different, are hydrogen, optionally substituted alkyl, optionally substituted cycloalkyl, optionally substituted cycloalkenyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted phenyl or optionally substituted heterocyclyl, or R^5 and R^6 , or R^6 and R^7 , together with the atom(s) to which they are attached can form a ring, q is 1 or 2 and Z is O or S.

10 Amino groups may be substituted for example by one or two optionally substituted alkyl or acyl groups, or two substituents can form a ring, preferably a 5 to 7-membered ring, which may be substituted and may contain other hetero atoms, for example morpholine.

15 The invention includes any compound of formula I and specifically exemplified.

The compounds of the invention have activity as fungicides, especially against fungal diseases of plants, e.g. mildews and particularly cereal powdery mildew
 20 (*Erysiphe graminis*) and vine downy mildew (*Plasmopara viticola*), rice blast (*Pyricularia oryzae*), cereal eyespot (*Pseudocercospora herpotrichoides*), rice sheath blight (*Pellicularia sasakii*), grey mould (*Botrytis cinerea*), damping off (*Rhizoctonia solani*), wheat brown rust (*Puccinia recondita*), late tomato or potato blight (*Phytophthora infestans*), apple scab (*Venturia inaequalis*), glume blotch
 25 (*Leptosphaeria nodorum*). Other fungi against which the compounds may be active include other powdery mildews, other rusts, and general pathogens of Deuteromycete, Ascomycete, Phycomycete and Basidiomycete origin.

30 The invention thus also provides a method of combating fungi at a locus infested or liable to be infested therewith, which comprises applying to the locus a compound of formula I.

The invention also provides an agricultural composition comprising a compound of formula I in admixture with an agriculturally acceptable diluent or carrier.

The composition of the invention may of course include more than one compound of the invention.

In addition the composition can comprise one or more additional active ingredients, for example compounds known to possess plant-growth regulant, herbicidal, fungicidal, insecticidal or acaricidal properties. Alternatively the compound of the invention can be used in sequence with the other active ingredient.

The diluent or carrier in the composition of the invention can be a solid or a liquid optionally in association with a surface-active agent, for example a dispersing agent, emulsifying agent or wetting agent. Suitable surface-active agents include anionic compounds such as a carboxylate, for example a metal carboxylate of a long chain fatty acid; an N-acylsarcosinate; mono- or di-esters of phosphoric acid with fatty alcohol ethoxylates or salts of such esters; fatty alcohol sulfates such as sodium dodecyl sulfate, sodium octadecyl sulfate or sodium cetyl sulfate; ethoxylated fatty alcohol sulfates; ethoxylated alkylphenol sulfates; lignin sulfonates; petroleum sulfonates; alkyl-aryl sulfonates such as alkyl-benzene sulfonates or lower alkylnaphthalene sulfonates, e.g. butyl-naphthalene sulfonate; salts of sulfonated naphthalene-formaldehyde condensates; salts of sulfonated phenol-formaldehyde condensates; or more complex sulfonates such as the amide sulfonates, e.g. the sulfonated condensation product of oleic acid and N-methyl taurine or the dialkyl sulfosuccinates, e.g. the sodium sulfonate of dioctyl succinate. Nonionic agents include condensation products of fatty acid esters, fatty alcohols, fatty acid amides or fatty-alkyl- or alkenyl-substituted phenols with ethylene oxide, fatty esters of polyhydric alcohol ethers, e.g. sorbitan fatty acid esters, condensation products of such esters with ethylene oxide, e.g. polyoxyethylene sorbitan fatty acid esters, block copolymers of ethylene oxide and propylene oxide, acetylenic glycols such as 2,4,7,9-tetramethyl-5-decyne-4,7-diol, or ethoxylated acetylenic glycols.

Examples of a cationic surface-active agent include, for instance, an aliphatic mono-, di-, or polyamine as an acetate, naphthenate or oleate; an oxygen-containing amine such as an amine oxide or polyoxyethylene alkylamine; an amide-linked amine prepared by the condensation of a carboxylic acid with a di- or polyamine; or a quaternary ammonium salt.

The compositions of the invention can take any form known in the art for the formulation of agrochemicals, for example, a solution, a dispersion, an aqueous emulsion, a dusting powder, a seed dressing, a fumigant, a smoke, a dispersible powder, an emulsifiable concentrate or granules. Moreover it can be in a suitable form for direct application or as a concentrate or primary composition which requires dilution with a suitable quantity of water or other diluent before application.

An emulsifiable concentrate comprises a compound of the invention dissolved in a water-immiscible solvent which is formed into an emulsion with water in the presence of an emulsifying agent.

A dusting powder comprises a compound of the invention intimately mixed and ground with a solid pulverulent diluent, for example, kaolin.

A granular solid comprises a compound of the invention associated with similar diluents to those which may be employed in dusting powders, but the mixture is granulated by known methods. Alternatively it comprises the active ingredient absorbed or adsorbed on a pre-granular diluent, for example, Fuller's earth, attapulgite or limestone grit.

Wettable powders, granules or grains usually comprise the active ingredient in admixture with a suitable surfactant and an inert powder diluent such as china clay.

Another suitable concentrate is a flowable suspension concentrate which is formed by grinding the compound with water or other liquid, a wetting agent and a suspending agent.

The concentration of the active ingredient in the composition of the present invention, as applied to plants is preferably within the range of 0.0001 to 1.0 per cent by weight, especially 0.0001 to 0.01 per cent by weight. In a primary composition, the amount of active ingredient can vary widely and can be, for example, from 5 to 95 per cent by weight of the composition.

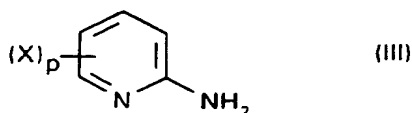
In the method of the invention the compound is generally applied to seeds, plants or their habitat. Thus, the compound can be applied directly to the soil before, at or after drilling so that the presence of active compound in the soil can control the growth of fungi which may attack seeds. When the soil is treated directly the active compound can be applied in any manner which allows it to be intimately mixed with the soil such as by spraying, by broadcasting a solid form of granules, or by applying the active ingredient at the same time as drilling by inserting it in the same drill as the seeds. A suitable application rate is within the range of from 5 to 1000 g per hectare, more preferably from 10 to 500 g per hectare.

Alternatively the active compound can be applied directly to the plant by, for example, spraying or dusting either at the time when the fungus has begun to appear on the plant or before the appearance of fungus as a protective measure. In both such cases the preferred mode of application is by foliar spraying. It is generally important to obtain good control of fungi in the early stages of plant growth as this is the time when the plant can be most severely damaged. The spray or dust can conveniently contain a pre- or post-emergence herbicide if this is thought necessary. Sometimes, it is practicable to treat the roots of a plant before or during planting, for example, by dipping the roots in a suitable liquid or solid composition. When the active compound is applied directly to the plant a suitable rate of application is from 0.025 to 5 kg per hectare, preferably from 0.05 to 1 kg per hectare.

Compounds of formula I where Z is O, W is O and R² is H may be prepared by reacting a dialkyl malonate of formula II:



where R¹ is as defined hereinbefore and R^a and R^b are each alkyl, with an aminopyridine of the formula III

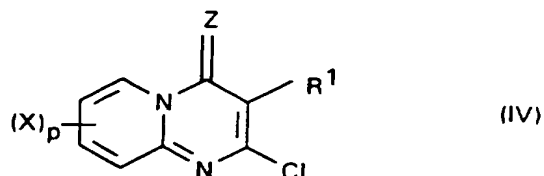


where X and p are as defined hereinbefore to give the corresponding compound of formula I.

Further compounds of formula I where W is O and Z is O may be prepared by reacting a compound of formula I in which R² is H in the presence of a base with a compound of formula R²Y where Y is a leaving group (e.g. chlorine, bromine, iodine or tosyloxy) and R² is as defined hereinbefore but is other than hydrogen.

5

Further compounds of formula I may be prepared via compounds of formula IV



where R¹, X and p are as defined hereinbefore, which may themselves be prepared by subjecting a compound of formula I where Z is O, W is O and R² is H to the action of phosphoryl chloride or thionyl chloride.

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For example, the compounds of formula I where W is O, S or NR³ and Z is O may be prepared by reacting a compound of the formula IV, where Z is O, with a compound of formula R²QH, where R² is as defined hereinbefore and Q is O, S or NR³ in the presence of a base.

15

Compounds of formula I where W is SO or SO₂ may be prepared from the corresponding compounds where W is S by oxidation in known manner.

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Compounds of formula I where Z is S may be prepared from the corresponding compounds where Z is O by reaction thereof with phosphorus pentasulfide in a known manner.

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Compounds of formula II are either known per se, or may be prepared in a manner known per se, for example as described in Chem Lett 1981, 367 or in Gazz Chim Ital, 1992, 122, 511, or in J. Org. Chem. 1986, 51(2), 183 by reacting a halide of formula R¹Hal where R¹ is as defined hereinbefore with a malonate of formula R^aOOC-CH₂-COOR^b where R^a and R^b are as defined hereinbefore. Other compounds of formula II may be prepared by methods analogous to those described in J. Am. Chem. Soc. 1946, 68, 1934 by reacting an aromatic acetic acid derivative with diethyl carbonate or chloroformate in the presence of a base.

30

Other methods will be apparent to the chemist skilled in the art as will be the methods for preparing starting materials and intermediates. The Examples also make apparent various methods of preparing compounds of the invention as well as starting materials and intermediates.

- 5 The invention is illustrated in the following Examples. Structures of isolated novel compounds were confirmed by NMR and/or other appropriate analyses.

Example 1

- 10 2-Amino-5-bromopyridine (1 g) and diethyl 3-thienylmalonate (2.8 g) were heated together overnight at 180°C under nitrogen. The mixture was then cooled and triturated with light petroleum (b.p. 40-60°C) to give 7-bromo-2-hydroxy-3-(3-thienyl)-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. >300° C. (Compound 1)

Example 2

- 15 Compound 1 (1 g), 1-bromobutane (0.5 ml), potassium carbonate (0.64 g) and dry dimethylformamide (10 ml) were stirred together for 2 days. The mixture was then poured into water, acidified with hydrochloric acid, extracted with ether, washed with water and dried over magnesium sulfate. Purification using silica gel chromatography gave 7-bromo-2-butoxy-3-(3-thienyl)-4H-pyrido[1,2-a]pyrimidin-
20 4-one, m.p. 132-3 °C. (Compound 2)

Example 3

- 25 2-Amino-5-bromopyridine (1 g) and diethyl phenylmalonate (3.11 ml) were heated together overnight at 180°C under nitrogen, by when a dark orange solid had formed. This was cooled and triturated with petrol (40-60°C) to give 7-bromo-2-hydroxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 305-6°C. (Compound 3)

Example 4

Compound 3 (1.3 g), 1-bromobutane (0.7 ml), potassium carbonate (0.89 g), and dry dimethylformamide (13 ml) were stirred for 2 days, and the mixture was then poured into water. The mixture was acidified with hydrochloric acid, extracted with ether, the extract washed well with water and dried over magnesium sulfate. Purification using silica gel column chromatography gave 7-bromo-2-butoxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 91-3 °C . (Compound 4)

Example 5

Compound 4 (0.78 g), *p*-chlorophenylboronic acid (0.36 g), sodium carbonate (2M solution) (2.4 ml), toluene (5 ml), and tetrakis(triphenylphosphine)palladium (0.12 g) was heated at reflux overnight under nitrogen. The mixture was then cooled and diluted with ethanol (3 ml), and a solid was filtered off which was dissolved in dichloromethane, washed with 1M hydrochloric acid, dried over magnesium sulfate and treated with a small amount of charcoal. The mixture was filtered to give 7-(4-chlorophenyl)-2-butoxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 187-9°C. (Compound 5)

Example 6

p-Toluenesulfonyl chloride (11.4 g) was added portionwise with stirring and ice-cooling to Compound 3 (15.9 g) in dry pyridine (100 ml). The mixture was allowed to warm to room temperature and then stirred for half an hour. It was heated for 4 hours at 60°C and allowed to stand at room temperature overnight. The mixture was added to a mixture of ice, hydrochloric acid and water, filtered and the solid which was collected was washed with water and ether and dried to give 7-bromo-3-phenyl-2-*p*-toluenesulfonyloxy-4H-pyrido[1,2-a]pyrimidin-4-one.

In a similar manner there was obtained 7-bromo-2-methanesulfonyloxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one.

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A mixture of 7-bromo-2-methanesulfonyloxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one (1.1 g) and piperidine (0.5 g) in dimethylformamide (15 ml) was heated with stirring at 80 °C for 2½ hours. The mixture was added to ice-water and extracted with ether. The extract was filtered and the filtrate washed with water, dried and evaporated. The residue was purified by silica gel chromatography to give

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7-bromo-2-piperidino-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 153-5°C. (Compound 6).

In a similar manner, 7-bromo-3-phenyl-2-*p*-toluenesulfonyloxy-4H-pyrido-
5 [1,2-a]pyrimidin-4-one and dimethylamine gave 7-bromo-2-dimethylamino-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 127-30. (Compound 6a)

Example 7

10 Potassium t-butoxide (0.71 g) was added portionwise with stirring and cooling to butane-1-thiol (0.57 g) in dry dimethylformamide (15 ml) under nitrogen. The mixture was stirred for 15 minutes and then added slowly dropwise to 7-bromo-2-(2,4,6-trimethylbenzenesulfonyloxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one (2.5 g; obtained in a similar manner to the preparation of the starting materials of
15 Example 6) in dry dimethylformamide (20 ml). The mixture was stirred at room temperature under nitrogen overnight. It was added to ice-water and extracted with ether. The extract was washed with water, dried, filtered and evaporated. The residue was triturated with diisopropyl ether and filtered. The solid material was purified by silica gel chromatography to give 7-bromo-2-butylthio-3-phenyl-
20 4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 139-142°C. (Compound 7)

Example 8

A mixture of Compound 441 (see later; 1.5 g), sodium methoxide (0.73 g) and copper (I) iodide (0.17 g) in dry methanol (10 ml) and dry dimethylformamide (20
25 ml) was heated under reflux for 5 hours. The mixture was added to ice-water and extracted with dichloromethane. The extract was washed, filtered through kieselguhr, washed with water, dried and purified with charcoal and evaporated. The residue was purified by silica gel chromatography to give 2,7-dimethoxy-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 214-5°C. (Compound 8)

30

In a similar manner, Compound 477(see later), was treated with sodium metanethiolate to give 2,7-bis(methythio)-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 164-6°C. (Compound 8a)

Example 9

Copper (I) cyanide (1.07 g) was added to a solution of Compound 2 (3.7 g) in dry dimethylformamide (8 ml). The mixture was heated under reflux for 4½ hours under nitrogen. Dilute ammonia (10 ml of 0.880 and ice water (20 ml)) and ether
5 were added and the mixture stirred for 10 minutes. The mixture was filtered through kieselguhr and the ether solution separated, extracted with water and the ether extracts washed with water, dried and treated with charcoal and evaporated. The residue was purified by silica gel chromatography to give 2-butoxy-7-cyano-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 95-7°C. (Compound 9)

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Example 10

Sodium methoxide (0.16 g) was added to Compound 9 (0.95 g) in methanol (30 ml) at with stirring. The mixture was stirred at room temperature for 3 hours and allowed to stand overnight. The mixture was added to ice-water, acidified and
15 filtered. The solid which was collected was washed with water and a little ether and dried to give 2-butoxy-7-[imino(methoxy)methyl]-3-phenyl-4H-pyrido-[1,2-a]pyrimidin-4-one, m.p. 135-6 °C. (Compound 10).

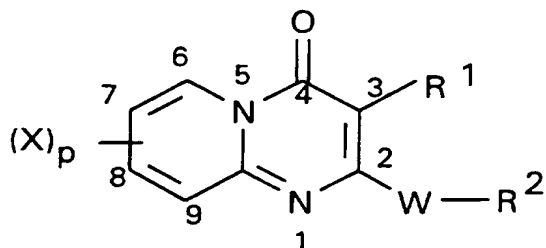
Example 11

20 A mixture of Compound 10 (0.47 g), hydrochloric acid (5 ml) and water (30 ml) was heated at 50 °C for 1½ hours. The mixture was cooled and filtered and the solid which was collected washed with water and light petroleum and dried to give 2-butoxy-7-methoxycarbonyl-3-phenyl-4H-pyrido[1,2-a]pyrimidin-4-one, m.p. 93-4°C. (Compound 11)

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The following compounds of the invention and intermediates were prepared in an analogous manner to one of the previous examples

For the avoidance of doubt the numbering of the ring is shown. It will be seen that the nitrogen common to both rings is numbered in position 5

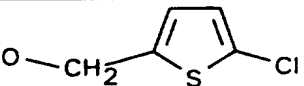


Cpd	WR ²	(X) _p	R ¹	m.p. (°C)
400	OH	7-Br	2-thienyl	> 300
401	OBu	7-Br	2-thienyl	145-7
402	OH	7-Br	2CF ₃ Ph	310-2
403	OPr	7-Br	2CF ₃ Ph	158-60
404	OH	7-Br	2OMe Ph	287-90
405	OH	7-Br	2,4 diFPh	320
406	OH	7-Br	2-pyridyl	252-4
407	OEt	7-Br	Ph	152-7
408	OH	7-Br	3ClPh	> 300
409	OH	7-Br	2Cl,6OMe Ph	> 300
410	OH	7-Br	2,4diCl Ph	> 300
411	OH	7-Br	2-(2,5diCl-benzyloxy)-Ph	271-2
412	OPr	7-Br	2OMe Ph	128-30
413	OPr	7-Br	2,4 diF Ph	141-3
414	OH	7-Br	2,6diCl Ph	> 300
415	OH	7-Br	4Cl,2NO ₂ Ph	> 300
416	OPr	7-Br	2,6diCl Ph	121-3
417	SCH ₂ CO ₂ Me	7-Br	Ph	156-8
418	OBu	7-Br	3-ClPh	109-10
419	OBu	7-Br	2-Cl,6-OMePh	153-4
420	OBu	7-Br	2,4-diClPh	145-7

Cpd	WR ²	(X) _p	R ¹	m.p. (°C)
421	OBu	7-Br	2-(2,5diCl-benzyloxy)-Ph	121-2
422	OH	7-Br	2-naphthyl	> 300
423	SBu ^t	7-Br	Ph	227-9
424	OBu	7-Br	2-naphthyl	112-3
425	SPri ⁱ	H	Ph	132-5
426	OH	7-Br	4-MePh	300-2
427	OBu	7-Br	4-MePh	136-8
428	OH	7-Br	4-ClPh	> 300
429	OBu	7-Br	4-ClPh	122-4
430	OH	7-Br	2-MePh	283-5
431	OBu	7-Br	2Me Ph	101-3
432	OPr	7-Br	4Cl,2NO ₂ Ph	152-4
433	OBu	7-Br	2,6diCl Ph	166-9
434	OPr	7-Br	Ph	137-9
435	Oallyl	7-Br	Ph	97-8
436	Opentyl	7-Br	Ph	146-8
437	OH	7-Br	4-OMePh	293
438	OCH ₂ CONH ₂	7-Br	Ph	230-2
439	OBu	7-Br	4-OMePh	128-30
440	OH	7-Br	4-BrPh	> 320
441	OMe	7-Br	Ph	181-3
442	OBu	7-Br	4-BrPh	127-9
443	OH	7-Cl	Ph	293-4
444	OH	H	Ph	308-9
445	OH	7-NO ₂	Ph	309-10
446	OBu	7-Cl	Ph	83-4
447	OPr	7-Cl	Ph	133-4
448	OE _t	7-Cl	Ph	145-6
449	OMe	7-Cl	Ph	187-8
450	OH	7-Me	Ph	315-6
451	OBu	H	Ph	84-5
452	OMe	H	Ph	140-1

Cpd	WR ²	(X) _p	R ¹	m.p. (°C)
453	OBu	7-NO ₂	Ph	134-5
454	OBu	7-Me	Ph	132-3
455	OEt	7-Me	Ph	137-8
456	OH	7,9-Cl ₂	Ph	260-1
457	OPr ⁱ	7-Br	Ph	173-4
458	O(CH ₂) ₂ Ph	7-Br	Ph	141-2
459	OH	7,9-Br ₂	Ph	229-30
460	OH	7-Br	4-FPh	321-4
461	OH	7-Br	3-FPh	302-5
462	OBu ^s	7-Br	Ph	73-4
463	OBu	7,9-Cl ₂	Ph	117-8
464	OPr	7,9-Cl ₂	Ph	131-2
465	OBu	7,9-Br ₂	Ph	115-6
466	OPr	7,9-Br ₂	Ph	142-3
467	OBu	7-Br	4-FPh	119-21
468	OPr	7-Br	4-FPh	130-2
469	OBu	7-Br	3-FPh	88-90
470	OEt	7-Br	3-FPh	140-2
471	OCH ₂ SPh	7-Br	Ph	133-6
472	OH	7-Br	2-FPh	294-7
473	OCH ₂ cyclopropyl	7-Br	Ph	129-31
474	OH	9-Br,7-Me	Ph	237-8
475	OBu	9-Br,7-Me	Ph	113-4
476	SPh	7-Br	Ph	
477	SMe	7-Br	Ph	216-8
478	OBu	7-Br	2-FPh	112-4
479	O Pr	7-Br	2-FPh	140-2
480	O-hexyl	7-Br	Ph	87-9
481	O-decyl	7-Br	Ph	60-2
482	OCH ₂ CO ₂ Me	7-Br	Ph	184-6

Cpd	WR2	(X) _p	R ¹	m.p. (°C)
483	OCH ₂ COBu ^t	7-Br	Ph	160-2
484	S-pyrimidin-2-yl	7-Br	Ph	242-5
485	OBu ⁱ	7-Br	Ph	109-10
486	OCH ₂ SiMe ₃	7-Br	Ph	
487	O-CH ₂ CH=CH-C≡C-Bu ^t	7-Br	Ph	224-5
488	OPr	9-Br, 7-Me	Ph	138-9
489	OEt	9-Br, 7-Me	Ph	146-7
490	OH	7-I	Ph	300-1
491	OCH ₂ -C(Me)=CH ₂	7-Br	Ph	142-3
492	OCH ₂ CH=CHCO ₂ Me	7-Br	Ph	166-7
493	OCH ₂ CH=CHMe	7-Br	Ph	117-9
494	OCH ₂ CH=CHCl	7-Br	Ph	105-6
495	O-4-Bu ^t benzyl	7-Br	Ph	83-5
496	OEt	7-I	Ph	169-70
497	OMe	7-SMe	Ph	167-9
498	OH	9-Me	Ph	272-5
499	OH	8-Me	Ph	330(dec)
500	OCH ₂ CH ₂ OMe	7-Br	Ph	111-3
501	OCH ₂ COPh	7-Br	Ph	141-3
502	OCH ₂ C≡CH	7-Br	Ph	223-5
503	Obenzyl	7-Br	Ph	103-5
504	OBu	9-Me	Ph	65-7
505	OPr	9-Me	Ph	113-5
506	OBu	8-Me	Ph	105-6
507	OEt	8-Me	Ph	147-9
508	OCH ₂ CN	7-Br	Ph	157-9
509	OEt	6-Me	Ph	95-7
510	O(CH ₂) ₂ SMe	7-Br	Ph	123-5
511	O-(4-OMebenzyl)	7-Br	Ph	164-7
512	O-(4-OCF ₃ benzyl)	7-Br	Ph	127-9

Cpd	WR ²	(X) _p	R ¹	m.p. (°C)
513	OBu	7-I	Ph	118-9
514	OCH ₂ CH=CMe ₂	7-Br	Ph	144-5
515	O-(4-CNbenzyl)	7-Br	Ph	212-4
516		7-Br	Ph	128-30
517	OCH ₂ -imidazol-1-yl	7-Br	Ph	104-5
518	O(CH ₂) ₂ O(2,4,6-Cl ₃ Ph)	7-Br	Ph	185-6
519	Otosyl	7-Br	H	144-59
520	OH	7-Br	4-pyridyl	319-22
521	OH	7-Br	3-pyridyl	308-11
522	OPri	9-Br,7Me	Ph	140-1
523	OCH ₂ cyclopropyl	9-Br,7-Me	Ph	101-2
524	OBu	9-Cl,7-CF ₃	Ph	44-8
525	OBu	7-Br	3-pyridyl	110-2
526	OPr	7-Br	3-pyridyl	129-31
527	OBu	7-Br	4 pyridyl	169-72
528	OEt	7-Br	4 pyridyl	154-6
529	OH	7-Br,9-Me	Ph	270(dec)
530	OH	6,8-Me ₂	Ph	234-6
531	OBu	7-Br,9-Me	Ph	119-20
532	OPr	7-Br,9-Me	Ph	174-6
533	OBu	6-Me	Ph	60-2
534	S-benzyl	7-Br	Ph	145-6
535	NMe	7-Br	Ph	198-200
533	OMe	7-Br	H	148-9
539	OH	6-Me	Ph	225-8
537	OBu	6,8-Me	Ph	90-1
538	OPr	6,8-Me	Ph	70-2

Test Example

Compounds are ass essed for activity against one or more of the following:

Plasmopara viticola: vine downy mildew

Erysiphe graminis f. sp. *hordei*: barley powdery mildew

5 *Erysiphe graminis* f. sp. *tritici*: wheat powdery mildew

Pyricularia oryzae: rice blast

Botrytis cinerea: grey mould

Venturia inaequalis: apple scab

Leptosphaeria nodorum: glume blotch

10 *Pellicularia sasakii*: rice sheath blight

Aqueous solutions or dispersions of the compounds at the desired concentration, including a wetting agent, were applied by spray or by drenching the stem base of the test plants, as appropriate. Plants or plant parts were then inoculated with appropriate test pathogens and kept under controlled environment conditions
15 suitable for maintaining plant growth and development of the disease. After an appropriate time, the degree of infection of the affected part of the plant was visually estimated. Compounds are assessed on a score of 1 to 3 where 1 is little or no control, 2 is moderate control and 3 is good to total control. At a concentration of 500 ppm (w/v) or less, the following compounds scored 2 or
20 more against the fungi specified

Plasmopara viticola

6a, 9, 10, 416-7, 423, 426, 428, 431, 436-8, 445, 453, 455, 458-9, 460-2, 465, 469, 473, 480, 516, 518-9.

25

Erysiphe graminis f. sp. *hordei*

2, 4, 412-3, 418

Erysiphe graminis f. sp. *tritici*

30 2, 9, 412-3, 418, 431, 434-7, 438-9, 441-2, 446-9, 451, 453-4, 457, 462-3, 465-70, 473-5, 477-82, 485-9, 491-6, 500, 502-3, 508-17, 519, 522-8, 531-2, 536.

Pyricularia oryzae

35 438, 475, 483, 490, 504-5.

Botrytis cinerea

509, 517, 536-7.

Venturia inaequalis

5 3, 413, 426, 432, 436, 491

Leptosphaeria nodorum

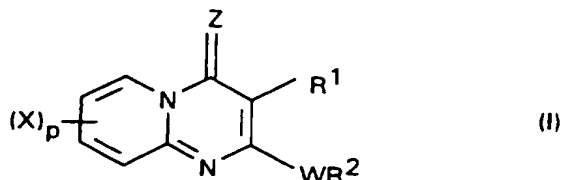
6, 410, 412, 443, 460, 470, 472, 474-5, 498, 500, 508, 511, 514-5

10 *Pellicularia sasakii*

435, 471, 525

CLAIMS

1. The use in combating fungi of the substituted pyrido[1,2-a]pyrimidinones of the formula I



5 wherein

R¹ is an optionally substituted aryl or heteroaryl group;

Z is O or S;

W is O, S(O)_n or NR³;

10 R² and R³, which may be the same or different, are each hydrogen or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group;

each X, which may be the same as or different from any other X, is halogen, CN, NO₂, SF₅, acyl, O-acyl, trialkylsilyl, B(OH)₂ or a group D, OD or S(O)_nD

15 where D is a group as defined hereinbefore for R² or is optionally substituted amino and n is 0, 1 or 2; or two adjacent groups X together with the atoms to which they are attached form a carbocyclic or heterocyclic ring;

p is 0 to 4; and

n is 0 to 2.

- 20 2 Compounds of formula I as defined in claim 1 with the exception of the following compounds where Z is O:

	R¹	WR²	(X) _p
	Ph	OH	6-NH₂
	Ph	OH	6-Me
25	Ph	OH	8-Me
	Ph	OH	-
	Ph	OH	9-OH
	Ph	Oallyl	-
	Ph	OCH₂CH₂NEt₂-	
30	4-OMePh	OCH₂CH₂NEt₂-	
	4-OMePh	OH	-



Application No: GB 9623593.2
Claims searched: 1,2

Examiner: Peter Davey
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Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5E (EAB), C2C (CLK, CQS, CTR)

Int Cl (Ed.6): A01N 43/54, C07D 471/04

Other: Online: CAS ONLINE

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	Chemical Abstracts 59:12819f,g	1,2
A	Chemical Abstracts 52:12872f,g	1,2

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family

A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

